REMARKS

Support for the amendment to Claims 1 and 9 is present in the Application Specification as originally filed, in Paragraphs [0015] at Page 1, lines 3 - 5, and [0049] and [0050], at Page 14, lines 5 - 23, for example. Support for the amendment to Claim 8 is present in the Specification as originally filed, in Paragraph [0019] at Page 6, lines 20 - 22, for example. Support for the amendment of Claim 15 is present in the Specification as originally filed, in Paragraph [0047] and Paragraph [0048], for example.

Rejection under 35 U.S.C.§ 112, second paragraph:

Claims 4 , 5 and 9 - 17 are rejected under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In particular, the Examiner indicates that Claims 4 and 5 are indefinite because the phrase "said radiation" refers to the preamble of Claim 1, which is not the Jepson part of the claim.

Applicants did not intend for Claim 1 to be a Jepson style claim, but after reading the Examiner's comments, applicants acknowledge that Claim 1 could be interpreted to be a Jepson style claim. Applicants have amended Claim 1 to make it clear that Claim 1 is not a Jepson style claim. Applicants submit that in view of the amendment of Claim 1, Claims 4 and 5 are no longer indefinite.

In addition, the Examiner indicates that Claims 9 and 15 recite the limitation "said imaged photoresist, and that there is insufficient antecedent basis for this limitation in these claims. Claims 9 and 15 have been amended to provide a proper antecedent basis.

The amendments to Claims 1, 9, and 15 have been made for purposes of placing the claims in proper format for consideration by the Examiner. None of the amendments to these claims have been made in view of any of the art cited by the Examiner.

Applicants contend that in view of the amendment of Claims 1, 9, and 15, Claims 4, 5, 9, and 15 are no longer indefinite, and the Examiner is respectfully requested to withdraw the rejection of Claims 4 , 5 and 9 - 17 under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Rejection Under 35 U.S.C. § 102(e):

Claims 1 - 3 and 8 are rejected under 35 U.S.C. § 102(e) as being anticipated by Kirkpatrick (U.S. Patent Application 2006/0084229).

With respect to 35 U.S.C. §102(e)(1):

The Kirkpatrick et al. application, which was published on April 20, 2006 (as Pub. No. 2006/0084299), was filed on December 2, 2005, and applicants' application was filed on April 2, 2004. The application which was published on April 20, 2006 does not qualify under 35 U.S.C. §102(e)(1) as a reference which may be cited against the present application, due to the filing date being subsequent to the invention by applicants, which was prior to April 2, 2004.

Under 35 U.S.C. § 102(e)(1), to be citable art, the invention must be described in an application for patent, published under section 122(b), and must be filed by another in the United States prior to invention by the applicant for patent. Since applicants' filing date was April 2, 2004 (and applicants must have made the invention prior to that date), and since the application which was published as Pub. No. 2006/0084299 under section 122(b) was filed on December 2, 2005, applicants must have invented the subject matter prior to the date on which the application published under section 122(b) was filed.

The Kirkpatrick et al. application cited by the Examiner is a divisional application of U.S. Application No. 10/752,885, which was filed on January 6, 2004, and which was published as U.S.2004/0266113 on December 30, 2004. This application would qualify as a reference under

35 U.S.C. §102(e)(1) , and applicants reserve the right to file a declaration swearing that their invention was made prior to January 6, 2004. However, applicants do not believe this will be necessary, since their invention is distinguishable from the subject matter described in U.S. Application No. 10/752,884 (which issued as U.S. Patent No. 7,018,925 on March 28, 2006).

The Provisional Application No. 60/438,112 on January 6, 2003, does not qualify as published under section 122(b), because provisional applications are not published under section 122(b), but are an exception to applications which are published under section 122(b). In fact, provisional applications are never published at all. Further, a utility application which is subsequently filed, claiming priority based on a provisional application, may be considerably different from and contain substantially more subject matter than the provisional application (and typically does contain substantially more subject matter). And, since that utility application is entitled to priority only for the subject matter which was present in the provisional application which was never published, it does not follow that a provisional application can be cited under section 122(b), which was intended to give benefit only to subject matter which clearly was in the hands of the applicants, as evidenced by the published application.

With respect to 35 U.S.C. §102(e)(2):

The invention must be described in a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of subsection 102(e)(2) of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

In this instance, U.S. Application No. 10/752,885, which issued as U.S. Patent No. 7,018,925 on March 28, 2006, which application was filed on January 6, 2004, would qualify as

a reference under 35 U.S.C. §102(e)(2), and applicants reserve the right to file a declaration swearing that their invention was made prior to January 6, 2004. However, applicants do not believe this will be necessary, since their invention is distinguishable from the subject matter disclosed in U.S. Patent No. 7,018,925.

Applicants contend that the application filed as Provisional Application No. 60/438,112, on Jan 6, 2003 does not qualify under et U.S.C. § 102(e)(2) because no patent was granted on the application having serial number 60/438,112. This Provisional Application was permitted to go abandoned. The application which was granted was granted on Application No. 10/752,885, filed on January 6, 2004, which issued as U.S. Patent No. 7,018,925 on March 28, 2006. Therefore, the only application date which applicants must be able to swear behind in terms of date of invention is Application No. 10/752,885. Again, applicants do not believe it will be necessary to swear behind the date of this reference, since the subject matter of this reference is distinguishable for the reasons provided below.

U.S. Patent No. 7,018,925, which issued on March 28, 2006, and which has the same application specification as the Patent Application Publication 2006/0084229 will be referred to in this response to the grounds of rejection under 35 U.S.C. §102(e). The Specification of the '925 patent describes and claims a method of fabricating a dual gate semiconductor device which includes a nitridated, high voltage dielectric within a low voltage region. The method includes a step in which, after development of a patterned photoresist (which development process leaves "an accelerant residue" from the photoresist on the exposed surface nitridated dielectric layer) a high vacuum is applied to the surface of the semiconductor device substrate to remove the accelerant residue from the surface of the nitridated dielectric layer. (Col. 2, lines 25 - 36.)

The present invention, as claimed in Claims 1 - 3 and 8, relates to a method of producing a photomask. The photomask structure does not include a nitridated dielectric layer. Further, there is no "accelerant residue" removed by application of a vacuum to a surface exposed by development of a photoresist in the method of the present invention. The purpose of the present

invention does not relate to the removal of a residue from a surface of a semiconductor device structure. The major purpose of the present invention is to equilibrate pattern critical dimensions in the photoresist across the entire photoresist layer, whereby an improvement in critical dimension and uniformity is achieved in the photoresist after development. (Paragraph [0014] Application Specification , Page 5, lines 3 - 5.) The method of the present invention may be used to provide an improvement in critical dimension and uniformity of a patterned photoresist, whether the photomask substrate has been exposed to an electron beam radiation or optical radiation. (Paragraph [0020] Specification, Page 7, lines 6 - 11.) This is because the invention pertains to treatment of the photoresist after imaging is completed within the photoresist, and does not depend on the kind or radiation or the length of time required to write the pattern into the photoresist. This invention is claimed in Claims 1 - 3, for example.

In all of the embodiments of the invention claimed in Claims 1 - 3, the equilibration process is carried out prior to the development of the pattern in the pattern imaged photoresist. The pattern imaged photoresist is a non-developed, continuous layer of photoresist which has been exposed to radiation to create a latent pattern within the continuous layer of photoresist material. Applicants apply a vacuum to this continuous layer of photoresist material to assist in the equilibration of the latent image of the pattern within the continuous layer of photoresist material. (Paragraph [0015] Specification, Page 5, lines 7 - 13) There is nothing in the Kirkpatrick et al. disclosure which relates to stabilization of a latent image of a pattern within a continuous, non-developed photoresist layer.

In other embodiments (including Claims 8 and 15), applicants wet develop the pattern imaged photoresist (to remove photoresist material which was exposed to radiation, creating openings in the photoresist) prior to applying a vacuum. In this instance, the application of vacuum is used to remove irradiation reactant by-products, moisture, and solvents from the developed photoresist, as a means of improving the line edge roughness of pattern openings

which were created during the development of the photoresist. (Paragraph [0017], Specification, Page 6, lines 20 - 22, for example) .

One skilled in the art reading a disclosure teaching about the removal of "accelerant residue" from the surface of an exposed nitridated high voltage dielectric layer in a dual gate semiconductor device would have no reason to relate this technology to a method of fabricating a photomask.

The overall subject matter of the present application is so far removed from the overall subject matter of the Kirkpatrick et al. reference that one of skill in the art would have no reason to combine these references, and the Examiner has not provided a prima facie case for anticipation, nor a prima facie case for obviousness.

The Examiner has cited the Kirkpatrick et al. reference because both the Kirkpatrick et al reference and the present invention make use of a vacuum which may be applied over a similar temperature and period of time. However, a vacuum may be applied at room temperature for a time period from minutes to hours in all kinds of processes which are used in industry in general. The vacuum in the Kirkpatrick et al. reference is used to remove residue from a surface of a nitridated dielectric layer during fabrication of a semiconductor device structure. In the major embodiments of the present invention, the vacuum is used to equilibrate an irradiated image, typically within a non-developed, continuous layer of photoresist material present on a photomask surface, whereby an improvement in critical dimension and uniformity of a patterned photomask is subsequently achieved. In the minor embodiment of the present invention, the vacuum is used to improve the line edge roughness of patterned openings present in a photoresist after wet development of a pattern in the photoresist. In both instances of the present invention, an application of vacuum is used in a different process for producing a different product, and is used to solve a different problem.

In view of the distinctions between the method of the present invention and the method described in the Kirpatrick et al. U.S. Patent No. 7, 018,925 (same specification as the Patent

Application Publication 2006/0084229), the Examiner is respectfully requested to withdraw the rejection of Claims 1 - 3 and 8 under 35 U.S.C. § 102(e) as being anticipated by Kirkpatrick (U.S. Patent Application 2006/0084229).

Claims Rejected Under 35 U.S.C. § 103(a):

Claims 4 - 7 and 9 - 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Kirpatrick in view of Itoh (U.S. Patent Application 2004/0058279).

Claims 4 - 7 depend from Claim 1, and are distinguishable over the Kirpatrick reference for the reasons presented above with respect to the 35 U.S.C. § 102(e) grounds of rejection of Claims 1 - 3. Claims 9 - 14 pertain to a method of patterning a layer of photoresist applied over a photomask substrate, where a vacuum is applied prior to the development of the pattern in the photoresist, for purposes of improving the critical dimensions and uniformity of a latent image in a photoresist. These claims are distinguishable over the Kirpatrick reference for the reasons discussed above with respect to Claim 1. Claims 15 - 17 pertain to a method of fabricating a photomask, where a vacuum is applied to a developed photoresist, for purposes of improving the line edge roughness of developed patterned openings through the photoresist. These claims are distinguishable over the Kirpatrick reference for the reasons discussed above with respect to Claim 8.

The Itoh et al. reference, U.S. Patent Application 2004/0058279, published March 25, 2004 is a divisional application of U.S. Application No.09/812,688, filed on March 21, 2001, which issued as U.S. Patent No. 6,660,455 on December 9, 2003. Since the application specification of the divisional application is the same as the patent Specification of U.S. Patent No. 6,660,455, applicants will refer to the '455 patent Specification in this response.

The Itoh et al. reference describes a specialized photoresist material which has been developed to compensate for problems observed when e-beam is used as the radiation tool to image a chemically amplified photoresist. (Col.1, lines 33 - 59; Col. 2, lines 54 - 68; and Col. 3,

lines 42 - 44.) The specialized photoresist material comprises an alkali-soluble resin; a photoacid generator, which generates an acid when irradiated with an electron beam; and a combination of first and second dissolution inhibiting groups. The first dissolution inhibiting group increases the sensitivity of the pattern formation when left to stand in a vacuum (under conditions of the kind which are present during writing of a pattern on a photoresist by an e-beam, which operates under a vacuum). The second dissolution inhibiting group decreases the sensitivity of the pattern formation when left to stand in a vacuum. By controlling the ratio of the first dissolution inhibiting group to the second dissolution inhibiting group, "the portion (of the photoresist) made soluble (in the alkali solution used to develop the photoresist) by the action of the photoresist is substantially held constant independently of the standing time in a vacuum". That is to say that the amount of time required to write the image, using an e-beam in a system which is under vacuum, does not affect the size of the pattern which is written, regardless of the time required to write the pattern. (Col. 3, lines 38 - 65.)

Figure 2 of the Itoh reference shows the change in the size of the image which is written by the e-beam as a function of time (described as vacuum standing time during which writing is progressing). Curve 21 shows the amount of dimensional change when the molar ratio of the second dissolution inhibiting group (which decreases sensitivity) to the first dissolution inhibiting group (which increases sensitivity) is 1 : 99; Curve 22 shows the amount of dimensional change when this molar ratio is 5 : 95; Curve 23 shows the amount of dimensional change when this molar ratio is 10 : 90; Curve 24 shows the amount of dimensional change when this molar ratio is 20 : 80; and Curve 25 shows the amount of dimensional change when this molar ratio is 50 ; 50. (Col. 9, lines 8 - 18.)

To show the amount of change in size of an image which is written initially and allowed to stand during the time period required to completely write the pattern over the entire photoresist, Itoh et al irradiated a pattern onto the photoresist and watched changes in the dimension of the pattern as time passed, under conditions which would occur during the e-beam writing of a

pattern on the photoresist (under a vacuum). Since the dimension of the irradiation beam written by the irradiation tool remains constant, the difference between the initially written pattern dimension and the pattern which is being written a subsequent time is the change which is occurring as a result of the molar ratio of the first and second dissolution groups. (Col. 9, lines 19 - 39.)

The determination is made as to the ratio of the two dissolution inhibiting groups which functions best in a given photoresist. The ratio which provides the best results is one where the soluble pattern formed in the material irradiated with an electron beam remains substantially constant, independent of the time required to write the pattern on the photoresist (independent of the standing time in a vacuum). (Col. 3, lines 59 - 65.) The recitation of the claim limitation about the ratio of the first and second dissolution inhibiting groups present in the photoresist is present in the independent claims for the pattern formation method, and the exposure mask fabrication method which appear in the Itoh et al. reference.

There is no description of any vacuum treatment of the photoresist to affect photoresist behavior in any of the Itoh et al. reference claims. This is because the vacuum referred to is not part of the process of imaging and developing the photoresist, but was merely part of an experiment to illustrate how the dissolution inhibiting groups would perform during pattern irradiation of the photoresist (which is carried out in the presence of a vacuum).

The applicants of the present invention are using a direct write laser or an electron beam to write a latent image into a photoresist. (Application Specification Paragraph [0006] at Page 1 lines 24 - 26, and Claims 4 and 5, for example.) Applicants are not developing a specialized photoresist in an attempt to provide an irradiated image which remains substantially constant, independent of the time required to write the pattern on the photoresist. Applicants are leaving this effort to the manufacturers of the photoresist materials.

Applicants have discovered that, for any of the chemically amplified photoresists, it is helpful to vacuum treat an a photoresist after completion of writing the irradiated pattern, and

prior to development of the irradiated latent image. This vacuum treatment "allows reaction by-product (which results from the irradiation), water vapor, and solvents, for example to desorb from the surface of the resist, improving critical dimension uniformity across the surface of the photoresist on the photomask substrate" (Paragraph [0015] at Page 5, lines 7 - 13 of the present application Specification.)

Applicants irradiate a photoresist to create a latent image of a pattern within the photoresist, treat the irradiated photoresist with a vacuum, and then wet develop the pattern to create a patterned photoresist. Since the reaction by-product from the irradiation, water vapor, and solvents have desorbed from the photoresist surface during the vacuum treatment, when the latent image within the photoresist (which is the pattern) is wet developed, the development process is more uniform, and the patterned photomask produced using the photoresist is more uniform. (Application Specification, Paragraphs [0014] and [0015] at Page 5.) Applicants' technique of treating the non-developed photoresist prior to wet development is applicable to all photoresists on the market, including the one described in the Itoh et al. reference. While the specialized photoresist described in the Itoh et al. reference, and its method of use, may help prevent the size of the line written during pattern irradiation from changing during the irradiation process, the Itoh et al. reference does not assist in the removal of reaction by-products, moisture and solvents from the photoresist prior to development of the photoresist.

In addition, in the embodiment of applicants' invention where the photoresist is vacuum treated after development of the pattern, there is an improvement in the line edge roughness of pattern openings through the photoresist due to the vacuum treatment. (Paragraph [0019], Specification Page 5, lines 20 - 22. The Itoh et al. reference does not even mention line edge roughness of the developed photoresist, but addresses only an irradiated image which remains substantially constant, independent of the time required to write the pattern on the photoresist.

The Kirpatrick reference describes and claims a method of fabricating a dual gate semiconductor device, which includes a nitridated, high voltage dielectric within a low voltage region. The method includes a step in which, after development of a patterned photoresist (which development process leaves "an accelerant residue" from the photoresist on the exposed surface nitridated dielectric layer) a high vacuum is applied to the surface of the semiconductor device substrate to remove the accelerant residue from the surface of the nitridated dielectric layer. The Itoh et al. reference describes a specialized photoresist and a method of using the specialized photoresist to pattern a photomask. The specialized photoresist material comprises a combination of first and second dissolution inhibiting groups which operate in opposite directions. By controlling the ratio of the first dissolution inhibiting group to the second dissolution inhibiting group, size of the irradiated line created by the irradiation source is substantially held constant during the writing of the pattern image into the photoresist.

One of skill in the art would not combine these two references which relate to significantly different subject matter. The Kirpatrick reference pertains to a method of semiconductor device fabrication, while the Itoh et al. reference pertains to photomask fabrication. The removal of an "accelerant residue" from a nitridated dielectric layer of a device surface does not provide guidance for a method of fabricating a photomask. The Examiner has not made a prima facie case for the combination of these references.

The timing and purpose of vacuum application in the Kirpatrick reference is different from the timing and purpose of vacuum application in the Itoh et al. reference. Further, the timing and purpose of vacuum application in the present invention is different from that in both of the references cited.

In view of the distinctions between applicants' invention and the references cited, the Examiner is respectfully requested to withdraw the rejection of Claims 4 - 7 and 9 - 17 under 35 U.S.C. § 103(a) as being unpatentable over Kirpatrick in view of Itoh (U.S. Patent Application 2004/0058279).

Applicants contend that the claims as presently amended are patentable over the cited art, and the Examiner is respectfully requested to enter the amendments requested herein and to pass the application to allowance.

If the Examiner would like to discuss any of the issues with respect to patentability of the amended claims, the Examiner is invited to contact applicants' attorney at the telephone number provided below.

Respectfully submitted,

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